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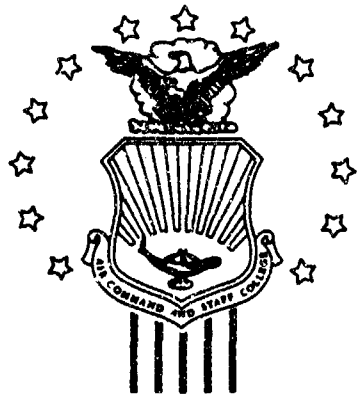


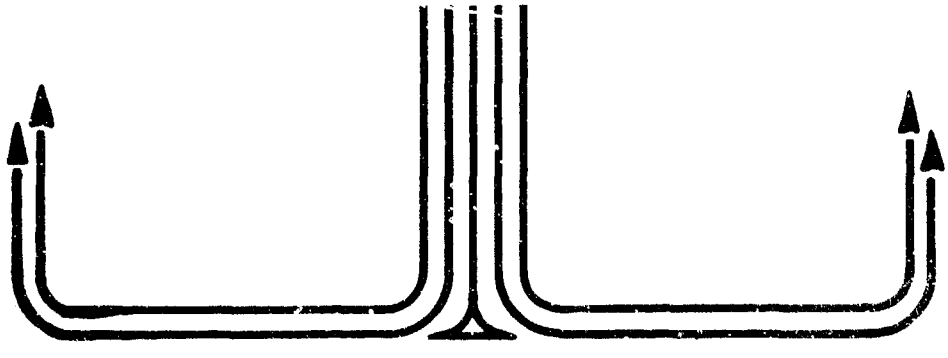
AIR COMMAND AND STAFF COLLEGE

STUDENT REPORT

INFLIGHT REARMING

Major Michael W. Cole 88-570

"insights into tomorrow"



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This research proposes a new type aircraft. Specifically, an Inflight Rearming Aircraft suitable for rearming combat aircraft in flight. The system is similar in concept to inflight refueling but, instead of transferring fuel, weapons are transferred. The idea is designed to work in conjunction with stealth aircraft because their design requires weapons be carried internally. This requirement for an internal weapons handling system makes it more practical to design one step beyond, i.e. automatic weapons transfer between aircraft.

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PREFACE

What a sight it must have been in 1929 to see two aircraft overhead with a black hose connecting them--stacked one on top of the other, the top one transferring fuel to the lower in history's first recorded attempt at air-to-air refueling. The Flying Question Mark, as it was called because of the way it looked from the side, played an important role in helping formulate future airpower doctrine. People witnessing the event stopped laughing at how silly it looked or how ridiculous the concept sounded when Lt. Carl Spaatz and Lt. Ira Eaker set a new aircraft endurance record. The term force multiplier probably hadn't been coined yet and only a few men of vision realized the potential of what Spaatz and Eaker accomplished. It wasn't until after a great war and nearly two decades later their idea received the attention they envisioned it should. Air-to-air refueling proved not only practical but now it's indispensable to conducting modern warfare.

As far-fetched an idea as air refueling was then, one suspects the same would be true today of an idea for air-to-air rearming of aircraft. However, when the author first discussed the idea about five years ago, those he'd talked to didn't think it ridiculous at all. Today as his proposal appears in print fighter, attack, and tanker pilots with USAF and Navy flying experience are urging him to press forward with the concept. Such encouragement led to many more hours of thought and working lunches, exchanging ideas and talking through workable concepts.

Given today's technology and even greater promise for future aviation designs, coupled with a "nothing is impossible" attitude, the author hopes to see this concept fly overhead one day. Like the Question Mark before, it may be the concept of aerial rearmament won't be practical for another 25 years. Nevertheless, let's evaluate it and use the ideas to stimulate creative thought and abilities of our aeronautical engineers and scientists and look to the future.

ABOUT THE AUTHOR

Major Michael Cole graduated from Southern Illinois University at Edwardsville in 1976 with a BS in Business Administration. Following Undergraduate Navigation Training in 1977, he was assigned to the 42nd Bomb Wing, Loring AFB, Maine, as a KC-135 navigator. While there he upgraded to instructor navigator and was squadron flying safety officer. In 1981 he was reassigned to the 19th Bomb Wing at Robins AFB, Georgia, where he was part of the initial cadre to form the 99th Air Refueling Squadron. While at Robins he was assigned to the instructor training flight and in 1983 participated in the Grenada invasion. He accumulated nearly 2000 hours flight time in seven years of active flying. In 1984 he was assigned to instruct at the Air Force's Squadron Officer School. While there he taught 17 classes of American and International officers. As an SOS instructor he was selected to attend ACSC in residence.

The Major is a graduate of SOS in residence, ACSC by correspondence and the resident program and has a Masters degree from the University of Southern California. He's previously published an article in SAC's Combat Crew magazine (August 1982) about aircrew safety.

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EXECUTIVE SUMMARY

Part of our College mission is distribution of the students' problem solving products to DoD sponsors and other interested agencies to enhance insight into contemporary, defense related issues. While the College has accepted this product as meeting academic requirements for graduation, the views and opinions expressed or implied are solely those of the author and should not be construed as carrying official sanction.

"insights into tomorrow"

REPORT NUMBER 88-570

AUTHOR(S) Major Michael W. Cole, USAF

TITLE INFLIGHT REARMING

This research proposes a new way for NATO and U.S. forces to counter the growing Soviet conventional advantage in Europe. The proposal is an Inflight Rearming Aircraft capable of rearming combat aircraft similar to the way they're refueled in flight. In the past, NATO's relied on technological superiority to offset Soviet numerical advantages but that gap is narrowing fast. Therefore, NATO must continue to investigate new ways to maintain any technical edge it can.

Central to any Soviet attack on the West will be the role played by Operational Maneuver Groups (OMG) which are characterized by speed and depth of penetration. These OMG's are characteristic of the "blitzkrieg" approach the Soviets will launch against NATO. Additionally, they symbolize just what NATO cannot afford to lose; NATO can't trade space for time as the Soviets did in WWII. Therefore, a system such as a rearming aircraft can keep aircraft at the front longer to maintain an offensive or give continuous support to a defensive position. Today's Airland battle allows for emerging technologies (ET) to fit into any future plans. Inflight rearming will allow aircraft to be refitted close to the front like Army combat vehicles are now. Another development of a rearming aircraft might be a hybrid design combining both

refueling and rearming capabilities in a single aircraft. Such a plane, whether hybrid or not, would contribute significantly as a force multiplier to any conventional force. Additionally, the Navy could use a smaller, carrier based version of the same type airplane. An Inflight Rearming Aircraft (IRA) would reduce dependence on runways and consequently make airbases and carriers less lucrative targets for the enemy.

The concept consists of three separate systems. The first is the Inflight Rearming Aircraft itself and would have to be a large cargo type airplane suitable for carrying transferrable weapons. A KC-10 or C-5B aircraft would be suitable for modification because of payload capacity and they're relatively new airplanes. The next development would come from the stealth aircraft designs and would make the whole idea plausible. Stealth aircraft will all carry their weapons internally so automatic systems necessary to handle the weapons will be integrated in the design itself. This fact makes it easier to go one step beyond and design an automatic inter-aircraft weapons transfer system similar in appearance to today's air refueling booms. This boom system will be different, however, than any other. It will be articulated and telescoping, allowing weapons to transit its length and enter the receiver aircraft in a nearly simultaneous operation.

Chapter 1

ESTABLISHING THE NEED/COUNTERING THE THREAT

The Warsaw Pact has significant numerical advantages in conventional arms over NATO forces in Western Europe. The trend forecasts the gap to grow rather than shrink and could lead to conventional blackmail by the Soviets. Soviet doctrine emphasizes the use of "blitzkrieg" warfare using fast reation forces capable of gaining early strategic advantages. Furthermore, NATO's qualitative edge in conventional arms is slowly eroding due to Soviet technological advances. One area NATO has capitalized on is using force multipliers to strengthen its forces. The author proposes a force multiplier, the Inflight Rearming Aircraft (IRA), to extend combat capabilities of fighter and attack aircraft. The IRA will effectively multiply the capabilities of NATO aircraft to help offset Soviet numerical superiority.

Excerpt from Hypothetical History book of the future:

The Russian armies began moving at 0700 hours on a Sunday, first leapfrogging around major cities and reinforced positions. Their airpower was well coordinated with the advancing land armies. Over 100 divisions were advancing on the German border defining a 400 mile front. NATO reacted quickly but was having great difficulty mounting a meaningful defense. In the opening rounds, the Russians overwhelmed some key American airfields and critical NATO command centers. NATO withdrew forces out of necessity, but did so in a planned and orderly fashion. NATO forces were inflicting significant losses on the Soviets by day six of the war but were still unable to stop or even slow the juggernaut. The Soviets advanced into the rich Ruhr region of West Germany and began to use NATO's resources (fuel, food) for themselves. More importantly, they'd denied NATO important war materials stocked in West Germany; NATO's position looked bleak. While NATO awaited resupply and reinforcements from the United States, the Russians suddenly stopped. Their tanks, APC's, troops, and aircraft stopped at the French border. They could have rolled on but didn't. They just stopped and waited. The Soviets issued a proclamation from Moscow. All they wanted was a reunited Germany; because of German atrocities in WWII, the Soviets were just in their actions. This was all they wanted and would attack no more unless NATO forces elsewhere in Europe, engaged in further acts of aggression against in-place Soviet forces. Russian tanks in a symbolic show of good faith lined along the Rhine and from vantage points overlooking the low countries, all at precisely the same moment, rotated their reactive armored turrets back toward the East.

Faced with this ultimatum, what should NATO do? The choices aren't appealing. The author proposes NATO and the U.S. need better forces to first, deter the Soviets from launching such an attack and secondly, to successfully repel an attack should it occur. The intent of this report isn't to analyze the effectiveness or validity of any Soviet or NATO strategy. The purpose is to introduce new ideas about ways to counter the threat more effectively, short of buying massive additional quantities of conventional arms on a one-for-one parity with the Soviets.

This idea realizes the greatest threat to NATO in Europe is from the Soviets' Operational Maneuver Groups (OMG) and suggests a way NATO can more effectively counter and ultimately defeat them (14:46). These OMG's take advantage of the Soviets' greater assets of men and material combined with speed and mobility. The OMG characterizes current Soviet thought on waging war in Europe and is designed to exploit an inherent weakness in NATO. NATO forces cannot afford, like the Russians, to trade space for time. Time works against NATO because, to successfully drive back a Russian attack, requires resupply from the United States. It's this time delay the Russian forces will take advantage of. The Russians are counting on quick victory before the United States resupply makes a difference (11:70-73). Therefore, defeating not only the OMG but all attacking elements of Soviet forces as quickly as possible is critical to NATO.

The OMG concept evolved from similar tactics tried and proven from wars past and are characterized by speed and depth of penetration (14:45). These are two characteristics the Soviets hope will cause great difficulties for NATO. OMG missions include capturing or destroying airfields and rear staging and repair facilities. The OMG is tasked to break through the forward lines of defense, to cause havoc in the rear areas before NATO mounts a successful defense. Larger Soviet forces can penetrate behind the breakthrough. These groups are highly organized forces using the latest Soviet weaponry including mechanized ground forces and aircraft. They are structured to be inside the NATO rear areas within 24 to 48 hours and create an intermingling effect among the forces to render the nuclear threat a much less viable option (14:47).

This "initial period" of war in Europe causes NATO planners the greatest difficulty. Current Soviet thought views the initial period as decisive (13:17). For example, they see the OMG achieving the main objectives early in the war. The Soviets see the initial period as critical not only in terms of length, i.e., very short, but also as determining early tactical advantage that, according to the Soviets' view, could well be a strategic advantage (13:17).

In the European theater the Warsaw Pact outguns NATO 3 to 1 in fighter aircraft, 1.6 to 1 in main battle tanks, and enjoys a significant numerical advantage in ground attack aircraft and attack helicopters (16:92-93). Given it's highly unlikely NATO will ever be able to reverse this trend, NATO relies on technological superiority and force multipliers to offset what it can't overcome in sheer numbers.

In view of this large and seemingly aggressive threat, the author proposes a new form of force multiplier, the Inflight Rearming Aircraft (IRA). It is similar in concept and usefulness to the air refueling tanker because it allows "receiver" aircraft to perform their mission longer and better. Until air refueling was perfected, airplane flight duration was dependent on onboard fuel limitations. Once inflight refueling became commonplace, aircraft endurance for all practical purposes was limited to mechanical malfunctions or aircrew tolerance. However, in war involving combat aircraft, another factor has always been an important consideration for pilots--ground forces and the threat.

This factor was the limit on how much ammunition an aircraft could carry in the form of missiles, bombs and cannon shells. It's the author's contention this no longer need be a limiting factor on aircraft battlefield capability. Considering the speed of Soviet forces coupled with the relatively short distances to cover to achieve significant battlefield advantages, it's imperative NATO stop them as quickly as possible. This could be done more effectively if aircraft could not only be refueled in flight but also rearmed inflight. The author proposes not only inflight rearming ground attack aircraft but fighter aircraft as well. Furthermore, inflight rearming will integrate with Airland Battle Doctrine, allowing NATO to control the air in Europe and defeat Soviet ground forces.

Historical accounts of aerial warfare are replete with examples of pilots having to leave the fight because of low-fuel or running out of ammunition (6:1-378). These stories don't reflect an alarming connotation because such a condition of air warfare is accepted as matter of fact. That is, aircraft always run out of something and must return to base to re-equip.

Inflight rearming will change that situation dramatically and offers Air Force and Naval fighter/attack planners more options. Air Force doctrine states: aerospace forces can be survivable (17:2-3). The author maintains they can be much more survivable through inflight rearming because of decreased reliance on recovery airfields for support. The only time an aircraft will spend on the ground will be for maintenance or to change pilots. The necessity to rearm at an airbase will no longer be as important a factor. For example, flight time to and from these airfields can save up to 1.5 hours per sortie for an A-10 in a European environment (18:--). Add turn around time on the ground refitting and one loses an attack aircraft for up to 2.5 hours. This assumes his recovery base hasn't been attacked by Soviet missiles or captured by an OMG, further complicating matters. Inflight rearming conversely could reduce time away from the Forward Edge of the Battle Area (FEBA) significantly. By positioning the rearming aircraft 10-15 minutes flight time from the battle, the only limitation left is pilot fatigue and aircraft attrition.

The value of inflight rearming would extend to other types of missions as well. Because of their higher speeds, fighters use less time getting to and from the battle. However, their same dependence on undamaged runways insures long periods away from the battle during turn-around operations (20:--). Search and rescue helicopter support could be continuous with only two fighters, one covering the chopper while the other rearms from the accompanying IRA orbiting overhead. Also, by applying the force multiplier concept, the number of aircraft required in a given situation is greatly reduced. For example, planners could use fewer aircraft for a battle or use the same number as before inflight rearming but provide more battlefield support. Furthermore, one acquires continuous and unrelenting force projection either to sustain an offensive or to support a defensive position. More importantly, it gives planners the ability to do much more with less. Finally, it denies the enemy advantages in and provides less incentive to destroy NATO airfields.

SUMMARY

Soviet victory in Europe lies less than a thousand miles from the Warsaw Pact forces, less distance than Hitler's armies drove into Russia in World War II. The Soviets could command all of West Germany in just 250 miles and then sue for peace. Either of these possibilities is a threat to NATO commanders and are equally as difficult to stop. The Soviet OMG coupled with vast land and air forces train to capture key NATO airfields, weapons sites, and command centers during the initial period of the war to achieve what they see as early strategic advantage. Additionally, NATO is outgunned in nearly every measurable category of conventional arms and the trend appears irreversible. NATO has in the past relied on technological superiority to provide an offset for the Soviet numbers it couldn't match. However, the technological gap is closing and NATO and the U.S. need to continue searching for ways to counter the Soviets whenever possible. The author proposes such a way with the Inflight Rearming Aircraft and describes ways the IRA can contribute to NATO's defense posture. The IRA works well with Airland Battle doctrine and promises even greater flexibility to force planners of the future. The IRA allows friendly forces to do much more with less and significantly increases NATO's control of the air. The next chapter describes how the IRA does this as a force multiplier. It does so from a historical standpoint, describing the consequences of aircraft running out of ammo in combat and ones caught rearming on the ground.

Chapter 2

A FORCE MULTIPLIER

NATO relies on force multipliers to better enable its forces to cope with an increasing Soviet threat. The aircraft's fullest potential hasn't been achieved yet, especially when compared to other fighting vehicles like tanks. Historical examples prove the vulnerability of aircraft while flying unarmed or grounded during rearming operations. The IRA can do for aircraft armament what the refueling tanker did for fuel supply: effectively increase it. Furthermore, the benefits of the IRA will be noticeable across a broad spectrum, from theater war in Europe to small-scale contingency operations.

Basic Aerospace Doctrine states: Aerospace forces can show presence, both in the sense of constant vigilance and alert as well as bringing persistent combat power to bear on an enemy's military structure (17:2-4). Furthermore, aerospace forces deploy quickly and can sustain themselves for extended periods of time (17:2-4). While this is generally true, the extended period is one the author questions. Because, to sustain a constant battlefield presence requires constant aircraft changeover. One aircraft can't remain at the front for an extended period and remain effective. Because of this, aerospace forces have to be proportionately larger than earth-bound combatants (tanks, trucks, etc.). Army combat vehicles arrive at the front and stay there, maintaining their presence, constantly being supplied from the rear while combat aircraft rely on replacement aircraft to sustain the attack (21:--).

Throughout the history of aerial warfare, aircraft had to leave the fight when out of fuel, ammunition or were shot down. Technology through air refueling has increased aircraft endurance, and is enhancing aircraft defense systems, but nothing's been done about dependence on ammunition to sustain a fight. In every modern war and every major air battle, aircraft ammunition has been an important consideration. In the closing days of WWII German interceptors attacking B-17 formations where instructed to ram the bombers when the fighter ran out of ammunition. In the Pacific, similar instructions were issued to aircraft attacking the great American surface fleets even before kamikaze attacks became the norm. When engaging American fighters, German aircraft with no ammunition but plenty of fuel would make several attack passes trying to break up formations intent on strafing German concentrations (14:70-71). Given the speed the Allies were advancing across the Pacific and Europe, these techniques were a chance to slow the advance until a better way could be found. And of course none were.

During World War I and II there were numerous examples of aircraft running out of ammunition or fuel and the defenseless pilot either benefited from airborne chivalry or was shot down by a not so generous adversary. Lt. Talmadge Ambrose, a P-47 pilot, describes a dogfight with a skilled German pilot in 1945. Neither pilot could gain an advantage to kill the other and, after several firing attempts by the German, the FW-190 pulled alongside and waggled his wings and pulled away. "I don't know if he was short of fuel or out of ammunition or if he was just letting me go. Nevertheless, I hit emergency boost and started to climb out of there" (7:104-106). In World War II, one German strategy during the Battle of Britain was to defeat the Spitfires and Hurricanes by exhausting their fuel and ammunition in nearly continuous dogfights (6:172). In the Battle of France and Poland, German Stuka dive bombers carrying only two bombs relied on force by numbers to achieve devastation (6:153). On the Russian front in 1940-41, the target environment was so rich German pilots literally couldn't turn their aircraft fast enough to shoot down or ground attack all available targets before being grounded by nightfall or bad weather. When the Russians went on the offensive, the same held true for them. In both cases sheer numbers prevailed, limited only by aircraft capability in fuel and ammunition/bomb load. In both cases it wasn't uncommon for pilots to fly 6 or 7 sorties per day (6:201-209). In Vietnam, countless A-1's, A-37's, and F-4's were needed for close air support missions when fewer could have done the same job with inflight rearming. Additionally, these aircraft had to break off ground support and return to base when out of ordinance (22:--).

An unarmed aircraft or one on the ground becomes a liability rather than an asset. On the ground, it's defenseless, endangers not only itself but support vehicles, maintenance people and, indeed, the base itself. There's no more beautiful sight to an attack pilot than explosions from destroyed enemy fighters parked on the ramp followed by secondaries from fuel trucks and bomb carts. A description by an Israeli fighter pilot during the 1967 Six-day War illustrates this. The Egyptian planes were still on the ground in neat rows and made easy economical targets. The Israelis wiped out lines of MIGS by the threes and sixes, and caught Russian built bombers in revetments. They hit fuel tanks, trucks, and buildings, spraying cannon, machine gun fire and bombs in pass after pass over the Arab bases. With air superiority assured, they followed up with attacks on the way home, hitting columns of tanks, entrenched and marching troops and other fortifications. They landed only long enough for fuel, ammunition and new targets (3:54). Likewise, an aircraft returning to base to re-equip is a liability because now it's an expensive target until it's airborne again. Indeed today's strategy requires aircraft to launch for survival if attack is imminent (10:25) because there's no more useless piece of equipment in war than an unarmed fighter on the ground.

This is why using the inflight rearming concept to multiply the utility of fighter/attack aircraft would prove beneficial. The imbalance between NATO and the Warsaw Pact, forces NATO and the U.S. to investigate all avenues to improve force multiplication. With NATO's E-3A and USAF's tankers the allies possess a degree of force multiplication from these combat support aircraft (10:22). An inflight rearming aircraft further enhances this posture and in the future could provide a decisive advantage. Estimates of buying a

separate tanker fleet for NATO increases the utility of fighter forces by 40% (10:25). Since there are no formal estimates of inflight rearming benefits, the author assumes the same improvement levels as inflight refueling. But refueling only enhances one aspect of aircraft capability and in a totally different way. Inflight rearming enhances capability differently. Force multiplication levels are difficult to determine when one has to figure increased combat capability in a fluid combat situation. With a fleet of tankers, NATO's air power projection is increased by a factor of two or three. Likewise, recent studies indicate an increase in fighter combat radius by factors of four to six depending on the number of tankers and where they're based (10:24). Similar, if not better, performance figures could be expected from inflight rearmable aircraft. Additionally, any future combination of tanker and rearming fleets could provide planners and strategists unprecedented mobility and flexibility for future wars. This flexibility enhances Airland Battle Doctrine, and allows commanders to do more with less (12:54). Additionally, future inflight replenishment aircraft might be a hybrid design, i.e., combination tanker, cargo and inflight rearming in one large aircraft, creating more flexibility and force multiplication.

The author, no expert on force multiplication equations, can only suggest the benefits of an attack airplane being able to pound enemy tank columns for hours at a time. Likewise, the fighter pilot who only has to fly to friendly CAP and rearming aircraft to return to battle with minimal time waste benefits, too. These scenarios are possible tomorrow in two ways.

First, the U.S. can buy vast new quantities of aircraft at tomorrow's $30 million plus prices and train the pilots to fly them and additional ground crews to maintain them. Or, it can design and build force multipliers such as inflight rearming aircraft to do the job within current aircraft procurement levels. During a war in Europe NATO may only enjoy limited or fluctuating periods of air superiority. Furthermore, because airfields will be prime targets for the OMG and Soviet bombers, one role for NATO fighters is airfield defense. Their mission is to protect runways for aircraft returning from combat to refuel and rearm. With inflight rearming one minimizes this requirement, because the airfield isn't as valuable to the enemy since fewer aircraft are on the ground. The benefits are two-fold: fewer aircraft using the base because they're at the front, consequently, fewer aircraft needed to protect the field.

The force multiplier effect will work outside the European theater and during contingency operations as well. In a contingency operation where the U.S. enjoys air superiority, an air rearming aircraft and a few fighter/attack airplanes could do the job of many more without inflight rearming. A relatively small airborne force could provide continuous support, hammering a beachhead, attacking armor, engaging fighters, etc. Without wasting time recovering to a base or an aircraft carrier, the forces are effectively and substantially multiplied.

SUMMARY

German pilots realized how useless an unarmed aircraft was, thus their strategy of continuous attacks on the British fighters to exhaust ammunition, forcing them to land so the Germans could attack while on the ground. During the massive air battles of World War II, pilot fatigue didn't cause as many problems as bad weather and nightfall. Flying six or seven sorties a day was the norm on the Russian Front. Consequently, an IRA and its ability to keep combat aircraft fighting longer gets historical support for the pilot's ability to cope with the stress of longer combat hours. Likewise, a combat aircraft on the ground becomes a liability, not an asset, and the IRA's job is to keep them at the front, influencing the battle longer. Examples from the Middle-East wars prove how disastrous results are when aircraft are caught on the ramp. Aircraft are expensive and the U.S. and NATO are constantly looking for ways to get more from what they have in the form of force multipliers like the E-3A and tankers. Buying one aircraft to double the utility of ten others is cost effective and improves dramatically force effectiveness across the board. Finally, an IRA allows friendly forces to project power more effectively during contingency operations using fewer assets at reduced cost.

Chapter 3

BATTLEFIELD EMPLOYMENT OF THE INFLIGHT REARMING AIRCRAFT

Using the IRA on the battlefield is where its advantages will be most evident. NATO and the United States must deter the Soviets in Europe with finite resources. The supply of F-16's has a limit and A-10's aren't produced anymore. Additionally, NATO has a time and distance problem in terms of how far and fast the Soviets must advance to defeat NATO. Consequently, NATO stages A-10's from rear areas, protecting the aircraft but diminishing its potential at the front. The IRA reduces the time spent in transit to the battle area and should diminish combat aircraft's dependence on runways during war. An additional benefit is achieved by allowing the same pilot to return to battle quickly while the tactical situation is still fresh in his mind. Lastly, the Navy can benefit from a carrier-borne IRA by limiting the time its forces must sit on the deck rearming.

A belief exists in the minds of combat pilots that says all the enemy aircraft you can shoot down doesn't mean a thing if you return to base to find the enemy tank commander eating lunch in your mess hall. This chapter describes various roles the Inflight Rearming Aircraft (IRA) would perform during wartime. The author describes these roles in a European war with the Soviets and deals with defeating Soviet "blitzkrieg" warfare central to Operational Maneuver Groups (OMG).

The primary ground attack (close air support) aircraft in the U.S. inventory are the F-16 and A-10 and are positioned in Europe and the United States. European basing includes all A-10's permanently assigned to RAF Bentwaters England and F-16's based primarily in West Germany (9:169). To more successfully counter the Soviet OMG's, A-10's stage from forward operating locations in Europe, some locations being classified (18:--). The A-10's permanent base in Europe is the 108 Aircraft "superwing" assigned to RAF Bentwaters (7:46). The rest of the discussion on Close Air Support concentrates on the A-10 since its primary mission is CAS and not dual role like the F-16.

For the Soviets to take full advantage of the OMG, it must be introduced into NATO defenses within the first 24 to 48 hours of battle to catch NATO unprepared and psychologically shock allied leaders to confuse their responses (14:47). Speed and surprise are the cornerstone to successful OMG operations. Of these two tactics, speed is the most dangerous to the tactician and once it's achieved, all defenders can do is delay or attempt to negate the enemy attempt at speed. Another key element of the OMG is the Soviet tank and armored personnel carriers. These vehicles are what the A-10 is designed to

destroy and it's essential to NATO's survival there are enough tank killers (A-10's) to deter or destroy Soviet armored advances. This is where ground attack forces can have the most impact.

Since USAF has no new A-10's coming on board nor is a follow-on yet built, the idea of making them more effective through inflight rearming appears more credible. The Soviets didn't halt tank production to coincide with the end of the A-10 production run. In fact, they add hundreds each year to their inventory making OMG operations even more lethal.

A reasonably successful OMG penetration is calculated at between 45 to 50 miles in depth behind the FEBA. This distance could be covered in days and is designed to capture key NATO airfields and resources. It's designed to create an intermingling effect with NATO forces rendering the nuclear defense impractical (14:47). Therefore, it's imperative ground attack forces be available in sufficient numbers and on a continuous basis to stop it. There's no doubt the 108 A-10's presently in Europe could mount a credible tank killing capability, especially when coupled with F-16's. However, attrition will cut these numbers, and the increased likelihood their forward operating locations could be captured jeopardizes their effectiveness.

A Soviet objective could take two forms, i.e., defeating West Germany or all of Europe. NATO planners know Soviet forces must travel just 275 miles across Germany or about 1000 miles to the Atlantic to be victorious. With an average speed of 30 mph (16:73) a Soviet tank could be on France's Eastern Border in about 10 hours. This short time period is only hypothetical, but illustrates how critical the time factor will be in a European battle. A-10's flying from England to stop the offensive would have precious little time to do it. Given their limited numbers, even with U.S. resupply efforts, time is a limiting factor. Consider that the Soviets have over 20,000 tanks committed to the Western theater of military operations (TVD) and the job for NATO's primary tank killers becomes ominous.

Current USAFE tactics require each A-10 and F-16 to fly six or seven sorties per day with each pilot airborne three to four times (18:--). Pilot fatigue shouldn't be the limit to battlefield performance since practice proves this rate possible. Additionally, many German and Russian pilots flew more than this throughout WWII (6:204). Additionally, each A-10 sortie is expected to kill 8 to 10 Soviet tanks in battlefield conditions favorable to the A-10 (18:--). A typical A-10 combat mission puts them over targets for only 20% of total mission duration, at this rate one can appreciate a system that keeps aircraft at the front longer. During a typical A-10 mission, the aircraft would fly 250 NM to the front taking about one hour to do so. It then has about 30 minutes at a combat power setting to seek out and destroy enemy armor before the hour flight home. At 30 minutes per aircraft and seven sorties per day, each aircraft could spend 210 minutes per day killing Soviet tanks. Those 210 minutes of combat time cost 14 flight hours getting to and returning from the battle area. Since the 210 total minutes represent only 20% of total aircraft flight time, it means to achieve the full effect of 108 airplanes at the front, one needs five times that many based in England. Since this isn't the case, it means only 20% (21.6 aircraft) at the front at a

time. And this figure assumes no losses or planes grounded for maintenance. Even if United States resupply efforts managed to bring half the 713 A-10's (9:146) ever built, the battlefield figure only rises to about 70 airplanes killing tanks at any one time--quite a feat along a 400 mile front facing 20,000 tanks with accompanying Soviet counter-air assets.

The Inflight Rearming Aircraft will reduce the A-10 and other combat aircraft dependence on recovery airfields to mount a sustained attack. The IRA can be positioned behind the lines in relative safety but moves as the battle lines change. Orbiting 50 miles behind the FEBA reduces distance by 200 miles a typical A-10 is required to return to base for rearming. This saves not only 45 minutes of flight time home to rearm but also the 45 minutes returning to battle. This assumes the A-10 can hit a tanker aircraft to refuel or the hybrid design described later. The inflight rearming process should take less time in the air than on the ground, so more time is saved there. Additionally, the pilot can relax, somewhat, while the automatic systems (Chapter 4) rearm his aircraft.

More importantly is the increased firepower friendly forces can bring to bear at a given time and place using the same number of assigned aircraft. When inflight rearming is used in conjunction with inflight refueling, a CAS aircraft could theoretically remain on station indefinitely. Furthermore, the IRA concept works best when used in conjunction with air refueling. For example, with 250 miles to fly to the front initially, neither rearming or refueling alone will increase its actual combat time. However, as the front gets closer to, or farther from, the support base it proportionately reduces or increases the amount of time each aircraft can engage in combat. Refueling increases range for combat operations while inflight rearming increases total time on target per sortie. Since the 30 minute time on target figure is based on a 250 NM flight to reach the FEBA and return to base with sufficient fuel, any distance less than 250 NM increases fuel available to remain in combat longer. For each 50 miles closer to the support base the front gets, A-10's can achieve about 10 minutes more combat flying time (18:--). However, a limiting factor then becomes the amount of weaponry it can release in a given time. In a target rich environment as envisioned in Central Europe, each A-10 for 30 minutes combat should kill 10 tanks (18:--). If the aircraft releases weapons faster, the advantages of inflight rearming should be obvious, the pilot shuttles back and forth to battle until fuel or fatigue forces him to leave the battle. If he releases weapons slower than normal, rearming is unnecessary as fuel becomes the limiting factor. With the hybrid design or a dedicated tanker and IRA on station, the utility of even a single CAS aircraft increases dramatically. With limited reliance on ground support to maintain combat operations, the IRA's contributions as a force multiplier are significant. The inflight rearming aircraft alone represents a force level multiplier of two or three depending on the FEBA proximity to refueling tankers and inflight rearmable aircraft (10:24). The IRA will contribute to force effectiveness in a way even more difficult to compute the benefits of.

Inflight rearming will allow the same pilots to return quickly to the battle they just fought--instead of returning hours later to find a whole new situation, possibly requiring different tactics in different terrain and

different enemy defenses. This quick return decreases the enemy's ability to use the principle of war of surprise and maneuver to gain advantages. Furthermore, it allows friendly forces to use the principle of logistics to greater advantage regarding aircraft than ever before. Consider how the Army uses logistics to support tanks and infantry at the front. It would be ridiculous to have each tank return to a rear area to replenish fuel and ammunition when it ran out. The Army has vast resources committed to ensuring this doesn't happen. The forward forces are constantly supplied from the rear to maintain a continuous hard hitting presence at the front (21:--). With inflight rearming and refueling, airpower would have the same logistical advantage as ground forces. Aircraft would spend much more time at the front fighting than in rear areas preparing to fight.

Still another example where inflight rearming will have significant advantages is in Naval aviation. With an even greater dependence on limited runways, i.e., carriers, the Navy has even less use for grounded aircraft during wartime than land based air forces. Aircraft caught on the carrier during combat are a greater liability than aircraft caught on the ground, because they now jeopardize the ship itself. The reasons are twofold: first, they're not up in the air defending the ship; second, they make a much more tempting target sitting idle. And sit idle they must from time to time, because they have to land to refuel and rearm. The Navy, like the Air Force, has perfected inflight refueling, but needs to land to rearm in order to return to the fight.

Admiral Nagumo could have used this capability when his aircraft were caught on flight decks during rearming operations in the battle of Midway in 1942. The battle lasted 48 hours but was won in 5 minutes when American dive bombers caught Nagumo's carrier decks lined with planes. His inability to inflight rearm aircraft cost him 4 carriers, 332 planes and hundreds of lives. He lost the battle and this was considered to be the turning point for the Naval war in the Pacific (1:61). The Navy could develop its own version of the Inflight Rearming Aircraft, one suitable for carrier operations, to guarantee Naval aircraft aren't caught on the deck out of requirement to rearm.

SUMMARY

The primary U.S. close air support aircraft, the A-10, is forward deployed to Europe to deter Soviet forces in the East. The Soviets plan to use speed and surprise from the OMG to overrun NATO defenses and render the nuclear defense impractical. The A-10 is a primary weapon to slow any Soviet rapid advance but is available in limited numbers. With the short distances the Soviets have to cover, it's imperative NATO stop the advances as quickly as possible. History proves pilots can withstand prolonged combat but, due to limited time (30 minutes) at the front, pilot fatigue may not be a factor. With the IRA an aircraft can fight a battle, depart for a brief time to rearm and then return to the same battle where the pilot's still familiar with the situation. This also provides friendly forces with nearly continuous airborne fire support and in effect multiplies our forces. This arrangement more

closely parallels the Army's logistical system in which forces remain at the front and are supplied from the rear. Finally, the Navy can benefit, too, with a carrier-based IRA suitable for rearming A-6's, F-18's and F-14's.

Chapter 4

THE RECEIVER AIRCRAFT

Stealth aircraft design features make them the logical choice to be the first inflight rearmable airplanes. To maintain their low radar signatures they'll carry weapons internally and launch externally. The mechanism required to do this can be an integral part of the rearming system as a whole. Various production weapons systems prove the capabilities of automatic weapons handlers and even smaller, more destructive weapons will make automatic weapons transfer systems more practical. Another characteristic of the receiver aircraft is its laser directed automatic flight control systems for use during rearming operations to maintain proper aircraft positioning.

While development of the IRA and its boom and internal equipment will be difficult, the receiver aircraft will be more so. Thanks in part to the ongoing development of stealth technology and the increasing complexity of combat planes, future aircraft design thought is experiencing almost daily changes. These rapid increases in technological sophistication of aircraft make it more logical to begin thinking of incorporating air-to-air rearming capability in the design. This design would be multi-faceted and differ from aircraft-to-aircraft depending on its mission and weapons load. Inherent to each design would be an internal automatic loading device suitable for external inflight hookup with the boom system from the IRA. This internal/external loading system is more easily devised and accepted as plausible given the characteristics future aircraft like the ATF and ATB are likely to have. Because of their low-observable features, stealth aircraft will carry their weapons internally to reduce radar cross-section thus increasing survivability (8:53). Internal weapons are necessary because external weapons and the hardpoints to carry them make an excellent radar return something future fighters can't afford to have. Internal weapons will be a standard feature on all "stealth" fighters of the future.

Because weapons will be carried internally but must be launched externally, some internal mechanism will be necessary to physically eject the weapon from the aircraft. A workable system might include an internal hardpoint internal hardpoint lowering clear of the aircraft into firing position then retracting quickly to reduce exposure time to enemy radar. This built-in weapons ejector makes it easier to design one step further a system for handling the weapon automatically from another system (the boom) on the IRA. The system simply described would be similar to loading an ammo clip on an automatic rifle. The aircraft would be "loaded" from the front near the nose or from the top of the wing (Figure 1). The weapons, whether missiles, bombs, or bullets then proceed via the aircraft's internal mechanisms to the

appropriate location inside the plane until ready for firing. Bombs could be loaded from atop the wing or the side of the fuselage, depending on the final storage location in the aircraft. This procedure most closely resembles the large caliber anti-aircraft gun clips used on AAA batteries aboard ships in WWII.

Missles, likewise, would be "injected" into the aircraft via the boom system. An entry point close to the launch point means the internal mechanism can be simpler and less costly. The missile handling system could be similar to the Navy's automatic missile handling system operated for years aboard surface ships. This system, manufactured by Food Machinery Corporation (FMC), is the Guided Missle Launch System (GMLS) and works automatically to bring surface-to-air missiles from storage areas below decks, and reload them in the ship missile defense system. The reload of this system is fully automatic and up to sixty missiles are stored within the magazine (5:152). This system concept, though different in operation, would be similar to that required on future fighters. The Navy system proves the ability of machines to handle safely, quickly and effectively such relatively delicate and dangerous weapons as anti-aircraft missiles.

Another proven weapons handling system is the automatic cannon loaders aboard some of the world's main battle tanks. Soviet designs using automatic loaders include the T-64 and T-72 (2:132). These systems handle cannon shells weighing 35 pounds and 125 mm in diameter. While these dimensions are considerably smaller than the 500 LB 400 mm diameter airborne weapons carried today (5:411), it does prove the feasibility of an automatic weapons handling system and could work in an aircraft.

While developing an internal aircraft system to handle today's weapons would be difficult, changes are already being developed in weapons design to make the task easier. Technological advances allow weapons size to change (i.e. get smaller) and achieve the same destruction as a larger weapon. This saves weight and reduces cost in some cases as well. A good example is the smaller European version of the AIM9-L, the ASRAAM, with more performance from a smaller size. Its diameter (13 cm) and length (9 feet) better enables it to intra-aircraft transfer and would be a possible candidate for an inflight rearming missile (8:875).

Any missile selected for inflight rearming should have folding fins because of the necessity to travel down the boom system and be stored internally in both the IR and receiver aircraft. Folding fins allow storage more compactly and permit a simplified handling system because the missile would be less delicate as a complete cylinder shape than a cylinder with delicate fins protruding from the rear. Future missile designs might include lifting bodies so fins wouldn't be necessary or use flush fins mounted at the tail and not protruding beyond the missile's diameter.

The transfer system within the aircraft could be one of several types with one purpose in common, moving weapons internally. The system could be powered hydraulically, electrically, or in combination. Additionally, it could be a simple conveyor belt set up or a worm-gear. These systems entail a

weight penalty but the space required for machinery and weapons storage could be provided by inherent design features of stealth aircraft. Most artists' impression of stealth aircraft incorporate tapered fuselage sides similar to the SR-71 aircraft. These elongations of the fuselage serve to enhance the aircraft's low radar signature, at the same time providing room for the weapons transfer system the author proposes. Furthermore, this shape provides room for additional weapons storage.

The last important characteristic of the receiver aircraft uses a laser system to maintain aircraft position during rearming operations. This system enables the pilot to position himself behind the IRA and, once in the rearming envelope, automatic systems take control to maintain position during rearming operations. The system uses a laser with sensing/sending units on the wingtips of the receiver aircraft with like units on the IRA. A triangulation effect would be used to keep position relative to the IRA and would be automatic when coupled with the receiver aircraft's autopilot and has two major advantages. First, it permits the receiver pilot a "hands-off" rearming operation, allowing him some relief from the rigors of combat operations. Secondly, it permits precision positioning of the two aircraft during the rearming process. Since the boom's position relative to the receiver aircraft will be important to keep in certain parameters, assistance from an automatic system will be crucial to success. This system could also be used on the hybrid design refueler/rearmer or incorporated into future refueling aircraft as well, solely for the purpose of pilot relief or more positive control during refueling operations.

SUMMARY

The most important aspect making the IRA a viable system is the need for stealth aircraft to carry weapons internally. Naval defenses using ship-borne surface-to-air missiles prove automatic systems can retrieve, load, and fire anti-aircraft missiles. Likewise, similar systems are in use to handle automatically more rudimentary weapons like tank shells and large caliber bullets in aircraft Gatlin guns. Furthermore, technological advances are allowing smaller and more powerful weapons, lending themselves to be more easily transferred in mid-air. The design considerations of stealth aircraft should make them more adaptable to the internal mechanisms necessary to carry internal weapons. Lastly, an important spin-off from the IRA is the laser/autopilot position keeper system used to ease pilot work load.

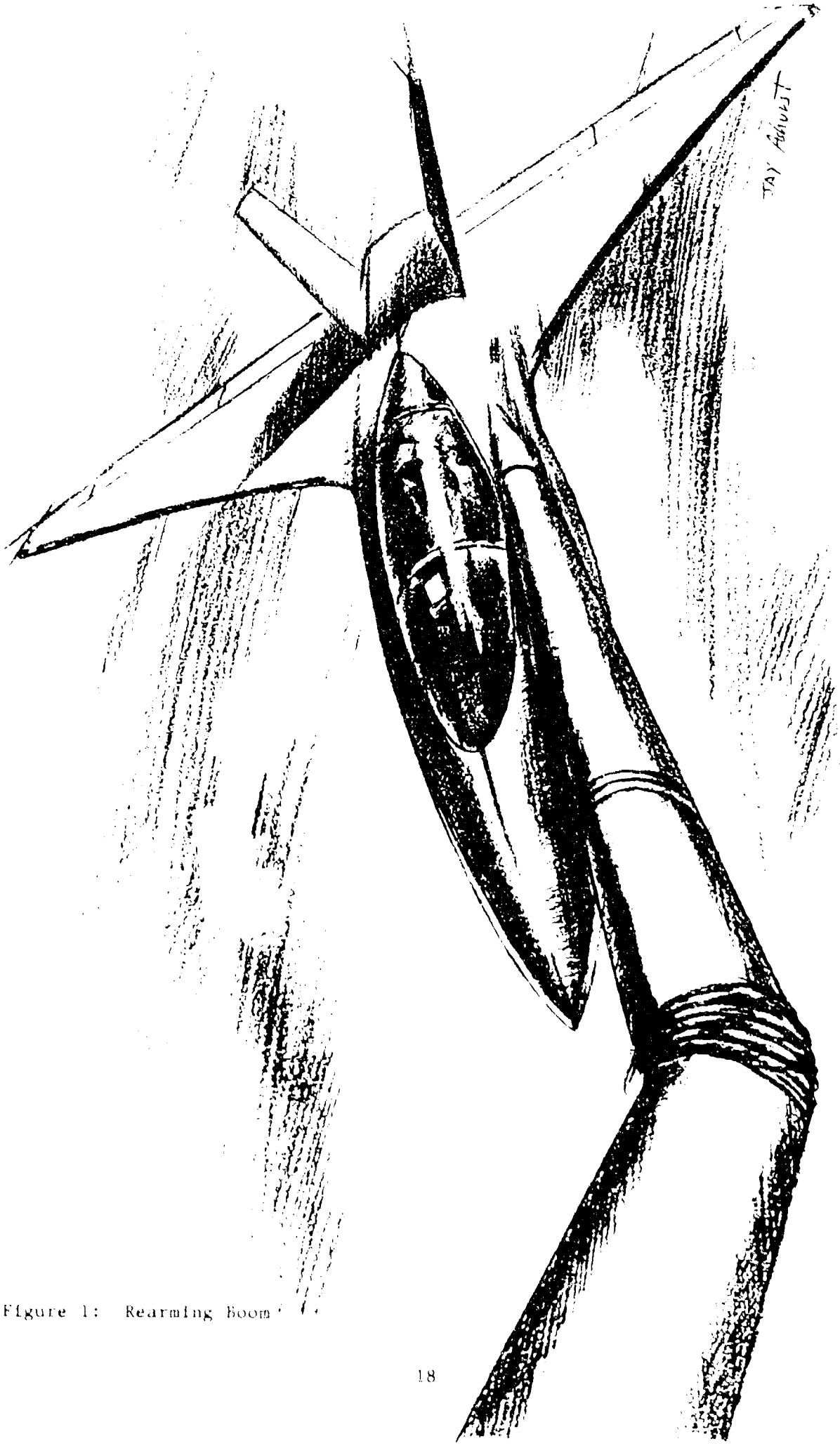


Figure 1: Rearming Boom

Chapter 5

THE INFLIGHT REARMING AIRCRAFT (IRA)

The Inflight Rearming Aircraft would be a large plane capable of carrying a large payload of transferrable weaponry. Several modern aircraft types are suitable; but a new design could be built using "stealth" technology like the ATF and ATB it will rearm. Furthermore, it could even be armed with missiles and ECM to provide self-protection. The aircraft interior arrangement will be a complex design arranged to store weapons on board and then transfer them inflight safely and efficiently. This design can be automatic or semi-automatic and will depend on cost considerations and reliability and maintainability standards desired. However, both systems will be man-operated to some extent because each require a "rearming boom" to operate as a critical element of the IRA system.

This aircraft would have to be a large one, preferably one already proven suitable for air-to-air work with receiver aircraft. The most obvious choice is the KC-10 with a possible role for the KC-135. The KC-10 is a more logical choice because of its greater size, more advanced technology and it's newer. Additionally, because of its sheer size, it could be modified more easily. Another possible choice for an inflight rearming aircraft would be an entirely new and advanced design. Such a plane would incorporate advanced composite construction with unducted fan engines. The design would allow for a large payload and the mission requires it have a very long loiter time. If an entirely new desing is chosen, it too could use stealth technology because of its likely operating location close to the battlefield. Current technology allows gross weights of large aircraft to exceed 800,000 pounds and payloads at these weights are about 250,000 pounds (8:230). At today's payload capacities, a futuristic rearming aircraft could carry a large number and considerable variety of offensive air weaponry suitable for air transfer. Assuming a 250,000 pound payload capability, the IRA's weapons load for a single mission could look like this:

Transferred Weapon	Weight With Support Hardware	Size	Max Carried
Missles - ASRAAM/AIM 9, etc.	200 lbs	287x13 cm	937
MK20 Cluster Bomb	350 lbs	diameter-335 mm with Fins Folded	535
30 mm, API Cannon Shell (for A-10's)	2.5 lbs	290mm x 30mm	75,000

Table 1. Jane's Weapon Systems 1984-85.

Such a load requires a rearming aircraft with Lockheed C-5B capability and one quarter of the payload allocated to on board rearming mechanisms, boom system and weapons storage racks, leaving about 187,500 lbs for munitions. This table represents ideal situations and whatever the weight capacity, the rearming aircraft is limited by space available to accommodate transferable weaponry. Additionally, most missions would dictate the aircraft carry a mix of transferable weapons, especially for a war in Europe scenario.

Although the aircraft wouldn't be a combat aircraft per se, it would nevertheless be a prime target for enemy gunners. Therefore, in addition to stealth characteristics the aircraft should have a self-defense capability. This could mean carrying its own air-to-air missiles and electronic countermeasure package. The aircraft should also be air refuelable to guarantee its loiter time lasts as long as its weapons load. A battle planner would want the aircraft operating close to but a safe distance from the combat zone, moving as the front changes. However, since its defenses would be limited, planners would want to use it the same way refueling aircraft are, behind the lines of battle relatively safe from intercept, or protect it with fighter CAP.

The aircraft interior will be as difficult to design as the boom system. The requirement to carry a variety of air deliverable weapons and to offload them safely is the basic technological requirement. The author envisions two options to future interior designs for such an aircraft. The first system operates automatically by on board aircraft systems designed to store and feed the boom system the desired weapons. Such automatic weapons loading systems are not unknown; some main battle tanks use them as do most heavy guns on warships (5:353-381). The obvious difference is the requirement to handle different sizes, shapes, weights and characteristics of air deliverable weapons. An additional requirement is arming the weapons and doing so safely either in the rearming aircraft, the boom system, or the receiver aircraft. Currently, engineers are experimenting with electronically arming aircraft weapons (18:--). Finally, the automatic system would entail a weight penalty due to its complex mechanisms and would be significantly more expensive than the author's second proposal.

Another way to work the delivery system inside the rearming aircraft would be a semi-automatic system with a man operating the mechanism via levers, gears, hydraulics, etc. One advantage would be simplicity--the weapons would be stored in the aircraft and the operator would select the desired one to offload. He could then configure and activate the transferring mechanisms. Another advantage would be a significant weight savings over automatic systems. The weight of automatic loaders, handlers, and adjusters necessary in the first example would be eliminated in a man operated system. Additionally, system design complexity would be significantly lower, thereby raising proportionally the system's reliability and maintainability. With this system, a degree of inflight maintenance would be possible with the "loader" adept as a mechanic as well.

Both these systems need a boom operator, whose job would be similar to the "boomer" on today's aerial tankers. His job in the IRA would be to operate the boom system from a pod similar to those mounted on KC-10s. From the pod the operator coordinates rearming procedures, offloads (weapons) requirements, etc. The boomer would fly the boom to its correct position and monitor systems while the receiver aircraft makes contact and assumes responsibility for keeping the boom in position via the laser system previously described.

SUMMARY

The IRA will carry a large weapons load to be cost effective and to rearm numerous aircraft per sortie. The KC-10 or C-5B are logical choices or a completely new design using stealth characteristics in a cargo aircraft. Either choice would carry a wide mix of transferrable weaponry and could be a hybrid tanker/rearmer aircraft as well. The on board systems necessary to offload weapons could be either automatic or semi-automatic with help from a man-operated system for the latter. Both systems require a boom operator to actually "fly" the rearming boom in position to mate with receiver aircraft.

Chapter 6

THE END

THE BOOM SYSTEM/CONCLUSION

The "boom" system is the critical link between the IRA and the receiver aircraft and will be a complex design system in its own right. It will be articulated and telescoping and will house the mechanism necessary to transfer weapons down its length. It will deposit them safely and securely inflight at the weapons entry point on the receiver aircraft. There are several proven methods to successfully accommodate intra-aircraft weapons transfer to include: mechanical worm-gears, air pressure, and a conveyer belt assembly. An alternative boom system would resemble a "cherry picker" and would handle weapons external to the receiver aircraft and would work with today's conventional fighter aircraft.

The boom will look somewhat like the boom installed on today's KC-10's. It will have to be about twice as large because it will be the actual medium for transferring weaponry inflight. For example, a typical 500 Lb bomb is about 400 mm in diameter (5:446); therefore, the author estimates the boom on the IRA would be about 1200 mm minimum in diameter. This size is necessary to accommodate a wide assortment of weapons but also internal mechanisms necessary to propel the weapons from IR aircraft to receiver.

The most obvious external difference in the two systems is how the IRA boom is articulated two-thirds the way down the boom. This is because the angle at which the boom attaches to the receiver aircraft while rearming is important. The boom's angle relative to the receiver aircraft is crucial because weapon size and rigidity will allow little offset from a parallel course from aircraft weapons entry point to final resting place within receiver aircraft. Additionally, the connecting point where the boom actually "hooks up" to receiver aircraft will require special attention to design. This point will require a fold away door flush with the aircraft while in flight but opening during rearming operations to allow weapons onload. Surrounding the opening will be appropriate toggles or latches to automatically grip the end of the boom to insure a safe hook-up.

The proper angle of the boom and receiver aircraft will be maintained by two means. First, the laser/autopilot system will keep the two aircraft in the proper flight envelope. Second, the boom's articulation at the joint between lower and upper portions and telescoping function of the upper part

will allow inadvertent motion between the two aircraft and keep the lower boom nearly motionless relative to the receiver aircraft.

As described in the previous chapter, the internal configuration of the IRA can be completely automatic or semi-automatic with human assist. Furthermore, the boom's internal configuration will be the same whichever loading system is chosen. The internal mechanisms will have one purpose--transfer the weapons safely and reliably down the boom system to the receiver aircraft. One possible configuration would be an internal worm-gear inside the boom itself. This would have to be a two part system--one in the upper and one in the lower section. This is a tried and proven transfer system used in industry but tends to be a relatively heavy but powerful system because of significant mechanical advantages the system can produce. Another method could use air pressure to force the weapons down an airtight boom. The weapons would have to be in sealed canisters of uniform size to achieve the transfer of different sized weapons in the same size boom. A third method, one the author favors because the Navy uses it aboard ship defense systems, is the conveyor belt assembly. The FMC MK 10 MOD 5 missile launcher and magazine uses a rotary drum magazine to store and position the missiles on the conveyor belt mechanism (5:152). The belt is electrically powered and transfers the missiles from magazine to firing position. The rotary drums would be in the IRA and the belt conveyor system in the boom itself and the missile attachment points in the receiver aircraft with its own intra-aircraft transfer system.

An additional feature of the boom is that the upper part telescopes. This function enables up and down movement by both aircraft without changing the hook-up angle to the receiver aircraft. Although figure 2 doesn't clearly show a telescoping function, it would be a barely noticeable feature while at rest. These two provisions, telescoping and the articulating joint, aren't features of the Navy's systems but would have to be designed into any airborne mechanism and are necessary to properly load the boom for rearming.

The boom system will be "loaded" prior to hook-up with the receiver aircraft. Weapons will proceed down the boom while its's in "trail" position, flying straight behind the IRA. It's necessary to have the lower part loaded prior to hook-up because most weapons won't be able to traverse between upper and lower parts while it's bent during rearming operations. Depending on the size of weapon, some can be stored in the lower part until that portion is exhausted, then a disconnect between boom and receiver has to occur. When this happens the receiver "backs out," the boom is flown straight again but not raised to normal flight position. While it's straight, the lower part is again "reloaded" and the receiver moves back in. This procedure shouldn't take but a few seconds since the upper half will already be holding weapons ready for transfer to the lower half. To ease pilot workload, the automatic laser/autopilot system described earlier could be computer programmed to accomplish this maneuver "hands off" for the receiver pilot.

Another system for consideration involves a mechanical arm in place of the boom. This "cherry picker" set-up would have an operator in the IRA offload weapons to conventionally configured receiver aircraft. This assumes a non-stealth receiver because the weapons would conventionally hang below the

fighter and be mounted to fixed external hardpoints. This system is more difficult to visualize but figure 3 helps. Essentially, this system has a sliding receiver weapons rail with a "male" fitting that slides forward from the receiver aircraft. The boom, with its weapon load extended outward from the end, flys near the sliding rail. The weapon itself has a "female" connecting rail suitable for sliding over the aircraft's extended male part. The IRA operator then injects the weapon onto the rail and it then retracts to its normal flight position under the receiver aircraft. Building this type rearming aircraft and boom system would mean a lot of money saved because the receiver aircraft requires much fewer modifications. Furthermore, current fighters and attack aircraft could be modified to work with it as well.

SUMMARY

The boom will have to handle safely and reliably a large assortment of weapons. The boom will be articulated to allow a better entry angle for weapons to transfer between the boom and receiver aircraft. Additionally, it will be telescoping to help keep the two aircraft aligned properly and to prevent inadvertent disconnect during rearming operations. The author proposes different types of transfer systems--conveyor belt, worm-gear and an air-pressure system--all of which have advantages. Finally, the author describes a cherry picker type system as an alternative to the more conventional boom used on refueling aircraft. This system literally places the weapon under the receiver's wing and could be used on conventional aircraft today.

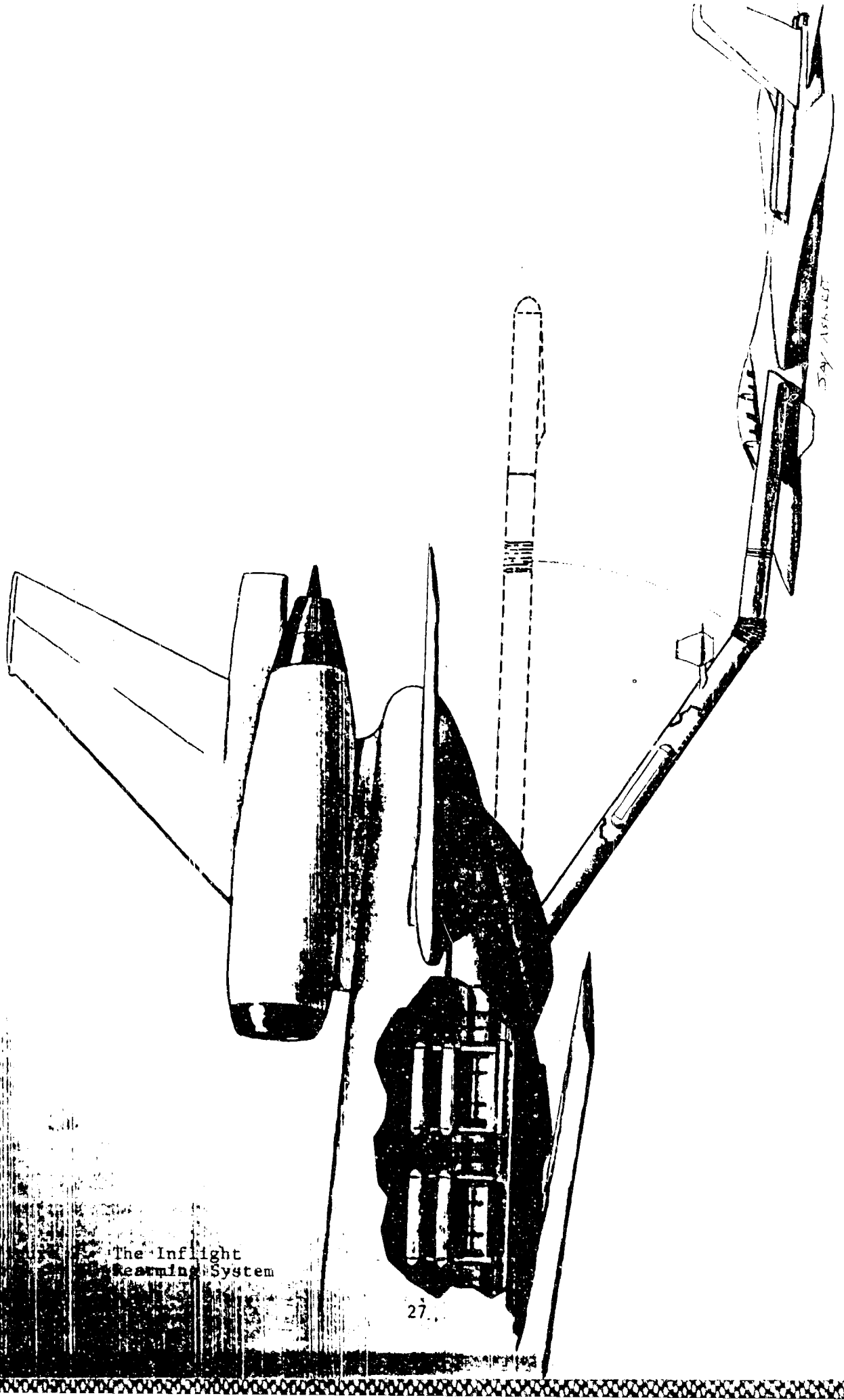
CONCLUSION

The author researched back to WWI to try and find any published information about inflight rearming, and none was found. Whether or not the idea is unique it is one which, in the author's opinion, needs to be carried the next step farther and tested in the USAF's weapons laboratories. The author recognizes the difficulties trying to retrofit current aircraft to the IRA concept but it's the future to which the author is looking to see this idea come to fruition. The idea itself is straightforward enough, but it isn't practical unless one considers the idea of stealth aircraft and the need to carry their weapons internally. Additionally, the requirement to arm weapons electronically, which is just now being attempted, will have to be used in this system as well.

The author interviewed pilots and crewmembers from many different aircraft types and was surprised at the enthusiasm for his idea. Not one said it couldn't be done; in fact, most offered ideas, some played the devil's advocate and helped solve their own misgivings. All were enthusiastic and offered encouragement to pursue the idea.

The military did without inflight refueling even after Lt. Spaatz and Lt. Eaker proved it would work. It wasn't until the idea was perfected a quarter century later that the USAF discovered it couldn't do without it. The

author, while recognizing his concept is more involved, costly, and difficult to validate, nevertheless, hopes to bend some ears with his proposal. With stealth technology being super secret and new ideas so expensive to incorporate, it may be the second generation of ATF's or ATB's that benefit from IR. The author does, however, fully expect to one day see or, in the case of stealth, read more about his idea and how it contributes as a force multiplier in tomorrow's Air Force.



The Inflight Rearming System

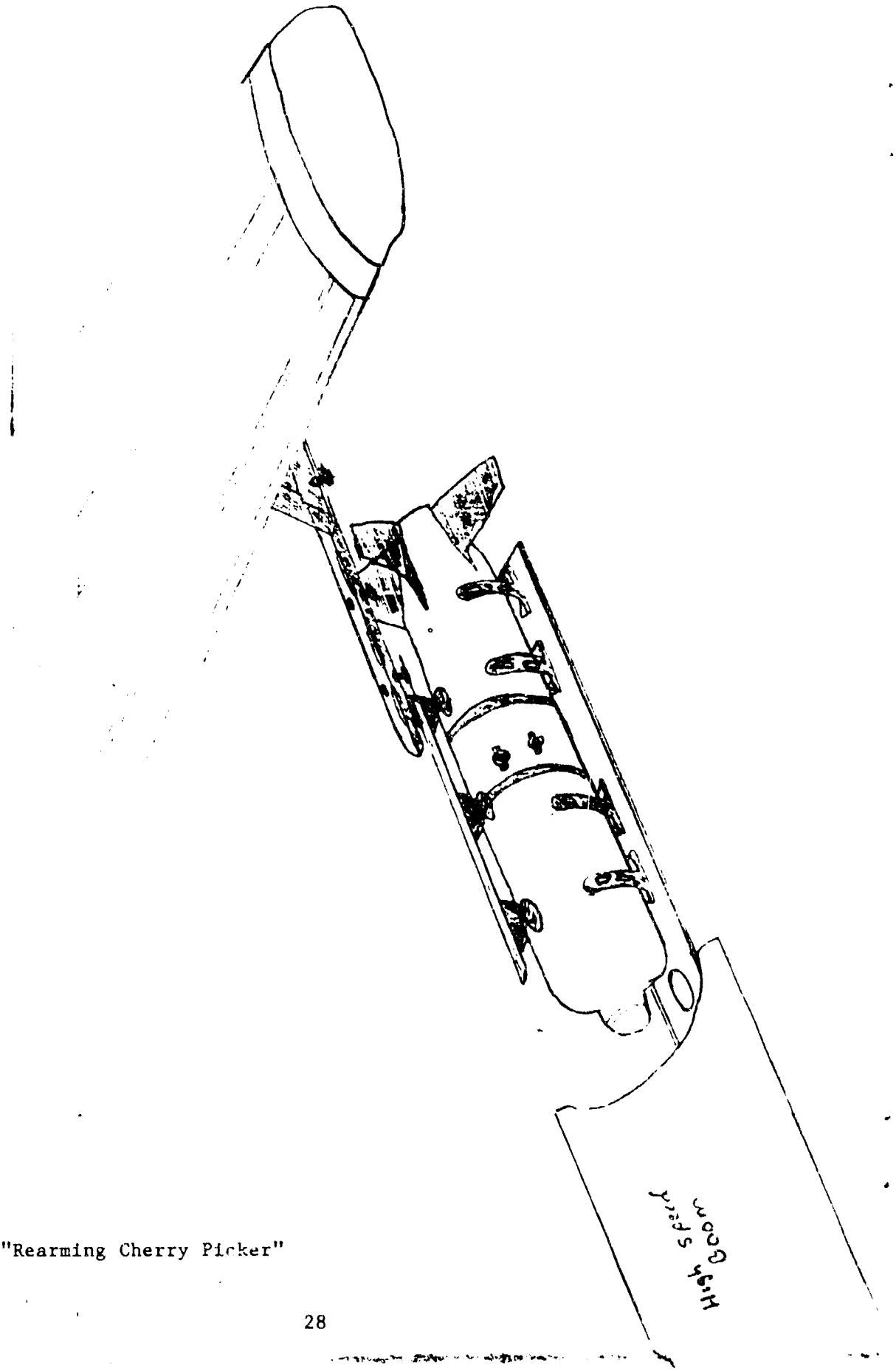


Figure 3: "Rearming Cherry Picker"

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21. Lenhart, Michael M., Maj., USA. Armor Officer, United States Army. Interview, 19 November 1987.

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